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Tasks involving several areas of cognitive functioning were given to 10 psychotic children and 30 normal children. Comparisons of performance were made between the two groups and also within the psychotic group. The dimension for differentiation was the psychotic children's varying degree of language facility. The psychotic children were classified into three language facility groups: functional, semifunctional, and nonfunctional. The cognitive abilities tested for were short term memory, discrimination, generalization, transposition, and discrimination reversal. They were chosen because they were significantly language-related or language-mediated. The results of performance on the cognitive functioning tasks showed that (1) the normal children performed consistently better than the psychotic children, (2) the language facility groups of the psychotic children differentiated their performance on the memory task involving a verbal cue, with the functional group performing best, and (3) certain trends in the data suggest a relationship between language functioning and cognitive performance on the tasks investigated. (WD)

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The University of Michigan

Center for Human Growth and Development

Cognitive and Linguistic Deficits in Psychotic Children

by

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Cognitive and Linguistic Deficits in Psychotic Children

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The study of abnormal behavior is important for two reasons. First it has a direct relevance for the education and treatment of individuals exhibiting abnormal behavior patterns. Second, by studying behavioral anomalies in individuals with known localizable physiological or psychological deficits it is possible to draw conclusions about the role of various structures and processes in normally functioning individuals. In this research we have compared the performance of psychotic children with that of normals on several cognitive tasks which were designed to expose the nature of the cognitive deficit which might be mediating the overall abnormal behavior patterns exhibited by these psychotic children. We were particularly interested in the role of language ability in cognitive functioning. Since our psychotic sample included a range of language ability from complete mutism to normal propositional speech some of the relationships between language functioning and cognitive performance could be examined. In addition, intensive behavioral therapy in the area of speech acquisition was utilized with two of the mute psychotics in an attempt to demonstrate longitudinal cognitive changes in the same subject as a result of increased language facility. (This phase of the research, which resulted in only minimal language acquisition, but a number of gross behavioral changes, will be reported in another paper).

The two major areas of cognitive functioning which were investigated were short term memory and perceptual discrimination. Both of these functions are generally considered to be vital in the integrated performance of the normal adult. Both Piaget and Heinz Werner have stressed the necessity of memory for immediate past experience for the process of cognitive development. Piaget (1952) states that the fundamental concept of object permanence cannot be achieved by the very young child unless he can coordinate

two different perceptions, one past and the other present, of the same object. Later the internalization of both concrete and formal operations is impossible unless the child can coordinate sequences of past experience, and thus allow for the abstraction of operations from these sequences. Werner (1961, p. 166a) points out the necessity of short term retention for the performance of delayed responses. Indeed, one of the characteristics of human beings which most sharply contrasts with lower animals is that of coordinating internal thought sequences as plans for subsequent often complex behavior (Miller, Galanter, and Pribram, 1960). This mode of operation would be impossible without some mechanism for short term retention of these plans. Finally, the organism must be able to perceive together both an action or thought and its result, either internal or environmental, in order to discover the nature of reality. The perception of either contingency or causality obviously depends on the ability to correlate present perceptions with past, or stored ones.

Discriminative functioning is also basic to mature cognitive activity. Of utmost survival value for almost any organism is the ability to act differentially to stimuli which differ, sometimes very slightly, from each other. Cognition is in part defined by the ability to form classes of stimuli which differ on certain meaningful dimensions (Bruner, Goodnow, and Austin, 1956). Human cognition is characterized by a great flexibility in both the dimensions which serve as a classificatory basis and the rules for class inclusion (cf Bruner et al's distinction between conjunctive, disjunctive, and relational concepts.)

Recent research has suggested that language, a function unique to humans, plays an integral role with respect to both memory and discriminative ability. There is a growing body of evidence which demonstrates that for certain age levels short term memory performance is facilitated by the child's verbalization of the stimulus to be remembered (Bernbach, 1967; Flavell, Beach, and Chinsky, 1966; Hagen and Kingsley, in press; Hagen and Meacham, 1967; Keeney, Cannizo, and Flavell, 1967). One factor in these results may be that verbalization provides a symbolic element which en-

ables the subject to rehearse the to-be-remembered material whether the material is itself symbolic or not. Another factor at least as important is the ability to restructure or recode the material through a symbolic medium such as language, so that it can be stored and retrieved more effectively.

Language is also implicated in several aspects of discrimination performance. Dietze (1955), Katz (1963), Norcross and Spiker (1957), and Spiker and Norcross (1962) have found that stimulus cues are differentiated more readily if they are associated to different verbal responses. Furthermore, ease of differentiation varies with the similarity between the verbal labels used. Verbal ability also facilitates correct discrimination after a switch in the correct value of the relevant stimulus dimension. The Kendlers (Kendler and Kendler, 1961, 1962), have amassed considerable evidence to show that at the age at which language becomes functional reversal shifts (shifts of reward contingency to another value on the same dimension of a multidimensional stimulus) are handled more easily than non-reversal or extra-dimensional shifts, whereas at earlier ages, and in lower animals, the opposite relationship is found. The transposition task, which involves the acquisition of a relational concept (i.e., choose the larger of two stimuli) is also believed to be language dependent, with non-language subjects tending to choose according to the absolute value on a given dimension of the stimulus rather than on the basis of a comparison between the values of two or more stimuli (Alberts and Ehrenfreund, 1951; Kuenne, 1946; Reese, 1966; Spiker, Gerjuoy and Shepard, 1956).

Finally, generalization of a discrimination to a new set of stimuli can be along a primary dimension, such as size in the transposition task, or between two different dimensions which are mediated by a symbolic (language) response. To the extent that a symbolic response is unavailable this type of generalization should be impossible.

This study compares the functioning of psychotic and normal subjects, and also that of psychotic subjects with varying amounts of language facility, on a number of these language-related cognitive abilities -- namely, short term memory, discrimination, generalization, transposition, and discrimination reversal. By these types of comparisons

we hoped to gain three things: First, further information on the role of language in several fundamental cognitive functions; second, certain specific loci of cognitive deficit in children diagnosed as psychotic; and third, some initial results which could lead to the differential diagnosis of severely disturbed children on the basis of differential cognitive deficit, and thus a more promising basis for treatment than present diagnostic systems allow.

Method

Subjects: Psychotic - Ten children, six males and four females, between the ages of six and eleven years (mean C.A. = 8.2) from Children's Psychiatric Hospital, University Hospital, Ann Arbor, Michigan. All of these children showed marked behavioral abnormality and have at one time or another been diagnosed as psychotic. Eight have been described as autistic. Of these Ss four were inpatients and six were day-care patients. They had been involved in the psychiatric program at CPH for periods ranging from one month to four years. The prognosis for recovery for all but three of the Ss is poor.

Normal - Thirty Ss enrolled in the Lansing School System[1] who were exhibiting academic performance normal for their ages. Five age groups were represented in the sample - 5-6, 6-7, 7-8, 8-9, and 10-11. The original design called for three boys and three girls at each age level. However, because of an error in selection of Ss, the 6-7 age group was represented by two boys and four girls, while the 7-8 group contained four boys and two girls.

Materials: Transposition, discrimination and generalization tasks - two series of wooden blocks were used as stimuli. The first series contained four cylinders, each 2 3/4 inches in diameter which varied in height. The shortest cylinder was 7/8 inches high and succeeding blocks increased in height in the ratio of 1:1.7. The second series consisted of three sticks which were 1 1/4 inches in height and depth, with variable length, the shortest being 1 11/16 inches long and succeeding members of the series in-

creased in approximately the ratio 1:1.8. A hole was drilled in the bottom of each block to allow rewards (M & M candies) to be hidden under the block.

Memory task - Materials for the short term memory task consisted of a deck of picture cards which measured 2 7/8 inches on each side. On each card was an unlabeled, brightly colored drawing of one of the following objects: truck, doll, clown, sailboat, kitten, or teddy bear.

Procedure[3]: A standard procedure will be described which was actually followed for normal Ss and some of the psychotics. For several of the psychotics the procedure varied somewhat. These variations will be mentioned below. Most Ss served in two sessions, each approximately one hour long and separated by one week.

Session 1

Discrimination - The two smallest cylinders were presented to S. An M & M candy was hidden under the larger of the two cylinders. S was told that candy was under one of the cylinders and he must try to find it. He was allowed to choose only one of the cylinders. If he chose the wrong one a new trial was initiated (i.e., a non-correction procedure). After each trial a three-sided box was placed over the blocks, while they were repositioned and reloaded if necessary. A random ordering for the rewarded position (left or right) was used with the restriction that within twelve trials reward was placed six times in each position. S was allowed to do as he pleased with the rewards he won. He could eat them immediately or save them to eat later. Criterion for attainment of discriminations was six consecutive correct choices.

Transposition - After S achieved criterion in the discriminations task the smallest cylinder was removed and the next largest in the series of four was added with no indication to S of the switch. Again, choice of the larger of the two cylinders was always rewarded. After six correct consecutive choices the smaller of the two cylinders was again removed and the fourth (or largest) cylinder added. Again S chose one of the two cylinders until the same criterion was met, with the larger cylinder correct.

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Generalization - After the second transposition the two shortest sticks were substituted for the cylinders, again with no indication of the change to S. Choice of the larger stick was always rewarded. After criterion the shortest stick was replaced by the longest and S again trained to criterion.

Short term memory - Image cue - In this task S was shown serially a series of picture cards and then asked to locate one of the cards in the series by presentation of a cue card which was identical to one of the cards just seen by S. Two, three and four card series were used. Each card in a series was shown to S for approximately two seconds and then placed face down on a table, forming a horizontal row in front of S. After S had seen the required number of cards, the cue card was shown to S with the instruction, "Give me the card which is the same as this one." S then chose one of the cards, his choice was recorded, and the next series was made up by E according to a prearranged schedule and exposed to S. At no time was the name of the object on a card expressed by E.

E started with series of two cards until S correctly matched the cue card in four consecutive series. He then increased the length of the series to three cards. After three consecutive correct responses, S was shown 12 4-card series. Data used in the analysis of memory performance was the number of 4-card series out of 12 to which S responded correctly. Serial positions of the correct card was counterbalanced across trials.

Session 2

Reversal shift - The discrimination and transposition tasks of Session 1 were repeated exactly using the cylinders. After S reached criterion on the second transposition task (on cylinders 3 and 4) reward contingency was reversed to the smaller of the two cylinders with no explanation to S. After S reached criterion on the reversal shift, the largest cylinder was replaced by the next smallest in the series (downward transposition) and again run to criterion with the smaller cylinder rewarded. Finally the larger of the two cylinders being used was replaced by the smallest of the series for a second downward transposition test.

Short term memory - Image and verbal cue - The same cards were used as in Session 1. S first was asked what he called each of the six objects on the cards. Then a procedure identical to that in Session 1 was used except that as each card was exposed E clearly enunciated the name which S had indicated for that card.

Six of the psychotic Ss who were involved in long range inpatient or outpatient treatment at the hospital exhibited considerable behavior aberrations when confronted with our cognitive tasks. Some of these aberrations were characteristic of their everyday behavior, while others were manifested when any demand was placed on them in the context of the therapy program. For these Ss training sessions were provided to involve them in the discrimination and transposition tasks. For example these Ss typically received a session in which the blocks were loaded in sight of S so that he would become acclimated to a task in which he had to choose one of the two stimuli to receive a reward.

The memory task, apparently not subject to improvement from practice with normal Ss, (Hagen and Kingsley, in press) was in many cases presented repeatedly to these Ss in a number of sessions until it was felt that S understood the reward contingency and seemed to be motivated toward good performance. This was the only way we could have assurance that performance in the task was representing either S's memory ability or his maximum willingness under normal circumstances to use this ability. In several cases initial performance was much worse than final performance and this discrepancy was probably caused by either lack of facility in abilities ancillary to the task or by initial uneasiness in the experimental situation.

Several of the psychotic Ss performed at chance level in the memory task. These Ss were given several trials in which the cards were placed face up rather than face down in order to insure that S could apply the concept "same" to the selection task (now a simple visual matching problem.) All psychotic Ss tested in this manner could perform the task correctly.

Results

Short term memory

Psychotic Ss fell into four age groups -- 5-6, 6-7, 8-9, and 10-11. An analysis of variance was applied to these groups and the corresponding normal age groups with three variables: Normal vs. Psychotic (N-P), Chronological Age and Memory Condition (MC) - presence or absence of verbal cue. These results are shown in Fig. 1. Memory score is the number of correct responses out of 12 in the 4-card condition. The dotted line represents chance level performance. Psychotics performed significantly worse than normals, $F(1, 24) = 26.74$, $p < .001$. This difference was significant for both the verbal condition ($F(1,24) = 12.30$, $p < .01$) and the non-verbal condition ($F(1, 24) = 32.12$, $p < .001$.

Insert Figure 1 about here

Verbal cue performance was superior to non-verbal, $F(1, 24) = 22.48$, $p < .001$). This facilitation effect was exhibited by both psychotic Ss ($F(1, 4) = 13.98$, $p < .05$) and normals ($F(1, 20) = 4.24$, $p < .06$). As shown in Fig. 2 however, the verbal cue was more effective in facilitating performance for psychotic than for normal Ss. For the MC x N-P interaction, $F(1, 24) = 8.32$, $p < .01$. Facilitating effect of the verbal cue decreased with age, indicated by an Age x MC interaction ($F(3, 24) = 3.56$, $p < .05$).

Insert Figure 2 about here

Neither the C.A. main effect nor the C.A. x N-P interaction was significant in this analysis. ($F(3, 24) = 1.26$ and 1.62, respectively.) However, a separate analysis of the normal memory data for these four age groups which included Sex as a variable, showed that Age was a significant effect for normals ($F(3, 16) = 5.94$, $p < .01$). This finding is consistent with results of other studies using similar tasks (Hagen and Kingsley, in press; Hagen and Meacham, 1967) and can thus be considered reliable. Inspection of Fig. 1 suggests no such age trend for the psychotic Ss.

Discrimination Series

Of the ten psychotic Ss, eight completed the entire set of discrimination tasks. The remaining two achieved criterion on the initial discrimination after a large number of trials but then showed no evidence of being able to transpose. Since each discrimination task was contingent on the preceding one, a score for any given task implies that S had succeeded in reaching criterion on the previous task. In the case of the two Ss who completed only the initial discrimination, the score for the first transposition was that at which testing was terminated although S had not reached criterion. For all tasks after the first transposition only eight psychotic Ss are included in the analyses. An additional S did not reach criterion on the reversal task. Therefore only seven psychotic Ss are included in the analysis of first transposition after reversal. It should be noted that by this procedure performance of the psychotic group may be biased in their favor.

Table 1 shows the differences between psychotics and normals on initial discrimination, first and second transposition, generalization, reversal, and first transposition after reversal. Since age trends for these tasks were not significant for either group, data were collapsed across age and sex, and simple one-tailed t-tests were used in the analyses. For initial discrimination, normal performance was superior to psychotic, $t(38) = 3.436$, $p < .005$.

Insert Table 1 about here

Normals transposed with fewer errors to criterion than psychotics on the first transposition after discrimination ($t(38) = 2.00$, $p < .05$), and also on the second transposition ($t(36) = 3.359$, $p < .005$). Normals generalized from the cylinders to the sticks with significantly fewer errors than the psychotics ($t(36) = 4.303$, $p < .001$).

In the reversal shift task, in which reward was made contingent on choice of the shorter, previously non-reinforced cylinder, psychotic performance was again inferior to that of normals ($t(36) = 4.858$, $p < .001$). This relationship also held for the first transposition after the reversal shift ($t(35) = 3.153$, $p < .005$).

Language and Cognitive Performance

Since it was hypothesized that language is related in some way to all the tasks used in this study, an attempt was made to assess cognitive performance for the psychotic Ss as a function of the degree of language facility they exhibited. The ten psychotic Ss were classified according to their level of language functioning. It was a simple matter for the investigators to agree on those Ss who manifested no functional speech at all and those whose speech was almost indistinguishable from that of children of comparable age. The former group, consisting of five Ss, was designated non-functional, and the latter, consisting of three, functional. The remaining two Ss about whom there was some uncertainty, were placed in an intermediate category, labeled semi-functional. Memory performance is compared between these groups in Fig. 3. While there was no improvement in the non-verbal memory condition with increasing language ability, there was an improvement in the verbal cue condition. Analysis of variance showed the main effect of language ability to be insignificant ($F(2, 5) = 1.51$, $p > .10$). However the interaction between language ability and memory condition was significant ($F(2, 5) = 8.01$, $p < .05$). Another way of expressing this interaction is to say that the degree to which a verbal cue aided performance was directly related to the functional language ability of S.

Insert Figure 3 about here

Table 2 presents performance of psychotics on discrimination tasks as a function of language proficiency. No attempt was made to test significance of differences between the three groups since failure of two Ss to perform after the initial discrimination reduced the total N to 8. However, certain trends in the data are strongly suggestive of a relationship between language functioning and cognitive performance on these tasks. There are three possible binary comparisons between the three groups on each of the six different tasks, or a total of 18 comparisons. Performance on the tasks is directly related to language ability in all but three of these comparisons. ~~Two~~ One of these reversals occurred on transposition after reversal, and ~~the third~~ two on the second transposition. In addition all three Ss who failed to perform the complete series are in the non-functional category.

Insert Table 2 about here

Discussion

Psychotic children, as hypothesized, performed significantly worse than normals on all discrimination tasks. More interesting, however, is the finding that in these tasks, in which the language function is hypothesized to be involved, performance varied with language ability. This finding supports those of a number of researchers working in the area of cognitive development (see Reese, 1962, for summary of this literature). In studies which show a qualitative change in cognitive performance with age it is assumed that language development, which is also a function of age, is the causal factor mediating the change. It is also possible that maturational changes are mediating both behaviors, and that language is not a causal variable, but rather a correlated one. For example, it is known that the frontal lobes, which are involved in the most complex integrative cognitive functions, are not fully matured until about 14 years of age. The findings of this study, on the other hand, are independent of the age of the subject. In fact it happened that age was negatively related to language ability in our psychotic sample. Mean ages of the non-functional, semi-functional, and functional groups were, respectively, 9.7, 9.5, and 6.0 years at time of testing.

Just as age-dependent results in other studies might be a function of central nervous system maturation, in our experiments language dependent results could be due to increases in overall brain disfunction rather than language itself.[34] We made an initial attempt to answer this question by dividing the psychotic sample into three categories of CNS debilitation -- extreme, moderate, and minimal. Assignment of Ss to these categories was done on the basis of EEG records and behavioral neurological examinations administered by one of the authors (B.W.). Each psychotic S was then categorized according to both speech ability and brain damage. The resulting distribution of Ss in the 3 x 3 matrix is shown in Table 3. In order to provide a factorial comparison of the effect of each of these

Insert Table 3 about here

variables on cognitive performance the row corresponding to maximal CNS damage was removed from the analysis. Separate 2 x 3 tables were constructed for each of the six discrimination tasks and cell, row, and column means computed. Adding mean scores for each language category caross the six tasks, total scores (errors to criterion) in order of decreasing language ability are 37.4, 36.5 and 18.7. For the two levels of brain damage total mean scores across language categories for the moderate and minimal groups are 33.5 and 27.9, respectively. Thus, while there is an indication that brain damage has some effect on cognitive performance, there is also evidence for an independent effect of functional language ability. The difference is most marked between those groups with some language and those with none at all.

Interpretation of the results for short term memory is somewhat ambiguous. Degree of facilitation caused by the verbal label was inversely proportional to age for both normals and psychotics, as shown in Fig. 1. However it was also found (Fig. 3) that facilitation occurred as a function of language ability. Since language ability in these Ss was in turn inversely related to age, it is impossible to determine which factor was more directly involved in the interaction.

In Fig. 4, Verbal and Image memory scores for the three language groups are plotted on the same graph as the curves for normals (same as in Fig. 1). Mean scores for the psychotic groups are placed according to mean age of the group in order to allow direct comparison with normals. The nonfunctional verbal group performed much more poorly on both types of memory than normals of the same age. They resemble very closely the 4-year old group in Hagen and Kingsley (in press). This group performed at the same level and also was not helped by verbal labels. They neither produced labels spontaneously nor used them when they actually produced the labels on instruction.

Flavell (Flavell, Beach, and Chinsky, 1966) distinguishes between these two types of deficit, calling the first "production deficiency" and the second "mediation deficiency". The functional group had no mediation deficiency. They performed suitably for their age when labels were provided. However, their chance performance when no label was supplied

suggests that they do have a production deficiency. In contrast, the normals in this study showed neither deficiency.

Much work in Russian developmental psychology is concerned with the vital function played by language in the planning and control of motor behavior, and sequences of actions directed at modification of the environment (Luria, 1961, 1966). Such goal directed sequences were rarely observed in most of our Ss. In addition Bettleheim, describing the behavior of autistic children, quotes Bosch, a German neurologist and psychiatrist: "In regard to the verbal development toward the concept 'I' we have shown that autistic children, to a large extent, lack the ability to actively reach toward the future. In dealing with objects they fail to experiment... They do not destroy, they do not modify, they do not investigate; instead they leave the objects exactly as they found them, or they repeat over and over again the same once-learned simple activity." (1967, p. 440).

Speech difficulty, and often complete mutism, is characteristic of these children and improvement in their adaptive ability is almost always accompanied by improvement in language usage. It may be that language disfunction is a central factor in the symptamatology of childhood psychosis. Consistent with this idea, during a period of operant language conditioning with two psychotic Ss in the nonfunctional language category we observed an increase in the degree to which these Ss interacted with objects, both human and nonhuman. Of course the main factor in this increase may have been not the verbal output itself, which was improved, but still minimal at the end of conditioning, but rather the intense interaction with the teacher or the establishment of reward contingencies during the conditioning sessions. Much more research will be necessary to isolate the effect of language production itself on adaptive behavior and the role of language in childhood psychosis. A study is planned which will test for cognitive changes as a result of increased verbal ability. If psychotic children show changes in cognitive abilities as they acquire language, similar to those changes shown by children in the course of normal development, through conditioning procedures, it can be argued that this language does play a similar mediating role. If no cognitive improvement occurs with increasing language facility, a deficit in mediational processing independent of the ability to produce language can be claimed.

Footnotes

[1] Now at Mount Sinai Hospital, New York City.

[2] Five children, one from each age group, were provided from each of six schools. We are indebted to the Lansing Public School System for its cooperation in making Ss available to us.

[3] Mr. Phillip Kingsley and Miss Betsy Winchell assisted in running the normal Ss. Psychotic Ss were run by teachers at CPH who were already involved with the theraputic treatment of these children and who were therefore known to them. Peter Wolff was present at every session and also supervised the normal sessions, thus providing considerable continuity of procedures between psychotic Ss and from psychotic to normal populations. We are indebted to Sharon Townsend, Kimberly Farley, and Ora Dailey for the many hours they contributed testing the psychotic children.

[4] We do not mean to suggest that language deficiency in our Ss was not itself associated with CNS damage. We are simply raising the possibility that extensive brain disfunction would be more likely to be associated with both language and cognitive deficiency.

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Table 1

Mean Errors to Criterion on Discrimination Tasks for Normal and Psychotic Ss.

Task	Normal	Psychotic
Discrimination	5.30	18.30
1st Transposition	.90	3.70
2nd Transposition	.13	1.88
Generalization	.33	2.38
Reversal	3.00	10.88
Transposition after Reversal	.77	2.00

Table 2

Mean Errors to Criterion on Cognitive Tasks as a Function of Language Ability

Task	Language Ability		
	Nonfunctional	Semi-functional	Functional
Discrimination	29.2	16.5	1.0
1st Transposition	6.6	1.0	.7
2nd Transposition	.3 (+ 2 ns*)	4.0	2.0
Generalization	3.7 (+ 2 ns)	3.5	.3
Reversal Shift	14.0 (+ 2 ns)	10.5	8.0
Transposition after Reversal	2.5 (+ 3 ns)	1.0	2.3

* ns indicates "non-solver", i.e. a S who has no score on a given task because he failed to reach criterion on a preceding task.

Table 3

Distribution of Psychotic Ss (N = 10)
on the Basis of Language Ability and CNS Damage.

CNS Damage	Language Ability		
	Nonfunctional	Semi-functional	Functional
Extreme	2	0	0
Moderate	1	1	1
Minimal	2	1	2

Figure Captions

Fig. 1. Verbal and Non-Verbal Memory Scores (Mean Number Correct on Twelve Trials) as a Function of Age for Normal and Psychotic Ss.

Fig. 2. Verbal$^{(V)}$ and Non Verbal$^{(I)}$ Memory Scores (Mean Number Correct on Twelve Trials) for Normal and Psychotic Ss.

Fig. 3. Verbal and Non Verbal Memory Scores (Mean Number Correct on Twelve Trials) for Psychotic Ss as a Function of Language Ability.

Fig. 4. Verbal and Non Verbal Memory Scores (Mean Number Correct on Twelve Trials) for Psychotic Ss in the Three Language Ability Groups, Plotted According to Mean Age of Each Group. Normal data (as in Fig. 1) are provided for comparison.

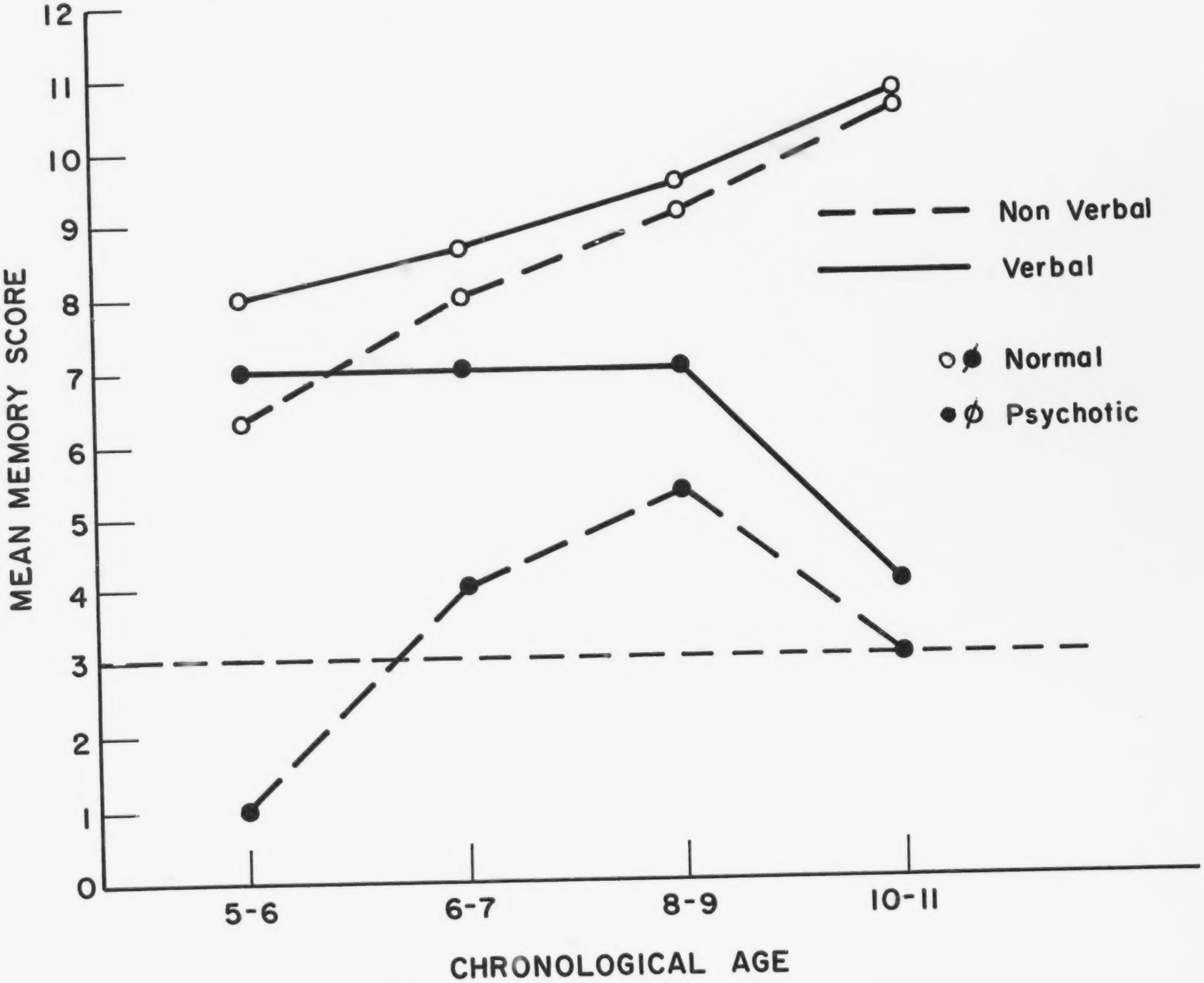
MEAN MEMORY SCORE
12
11
10
9
8
7
6
5
4
3
2
1
0
5-6
6-7
8-9
10-11
CHRONOLOGICAL AGE
Non Verbal
Verbal
Normal
Psychotic

Fig. 1.

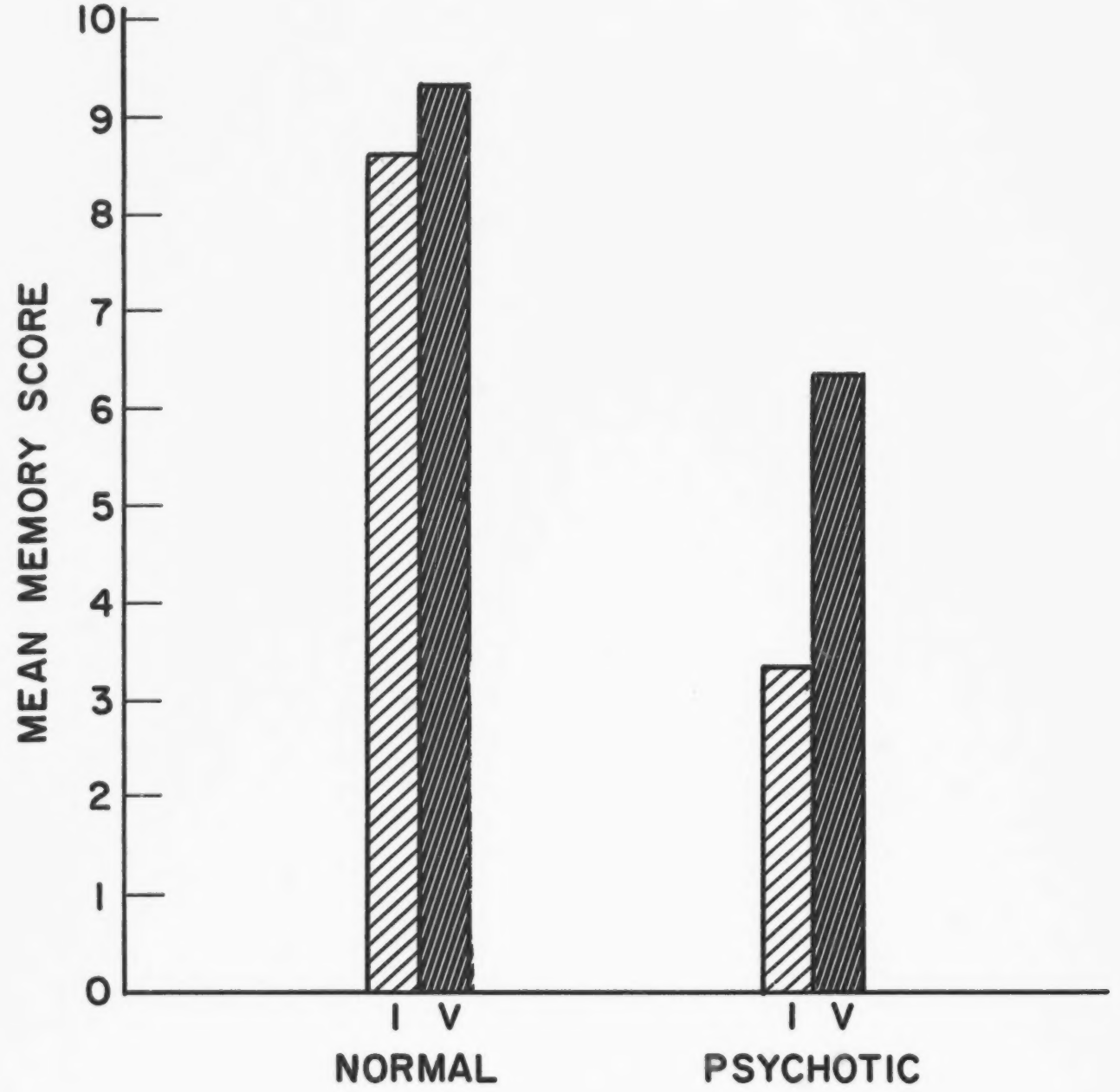

Fig. 2.

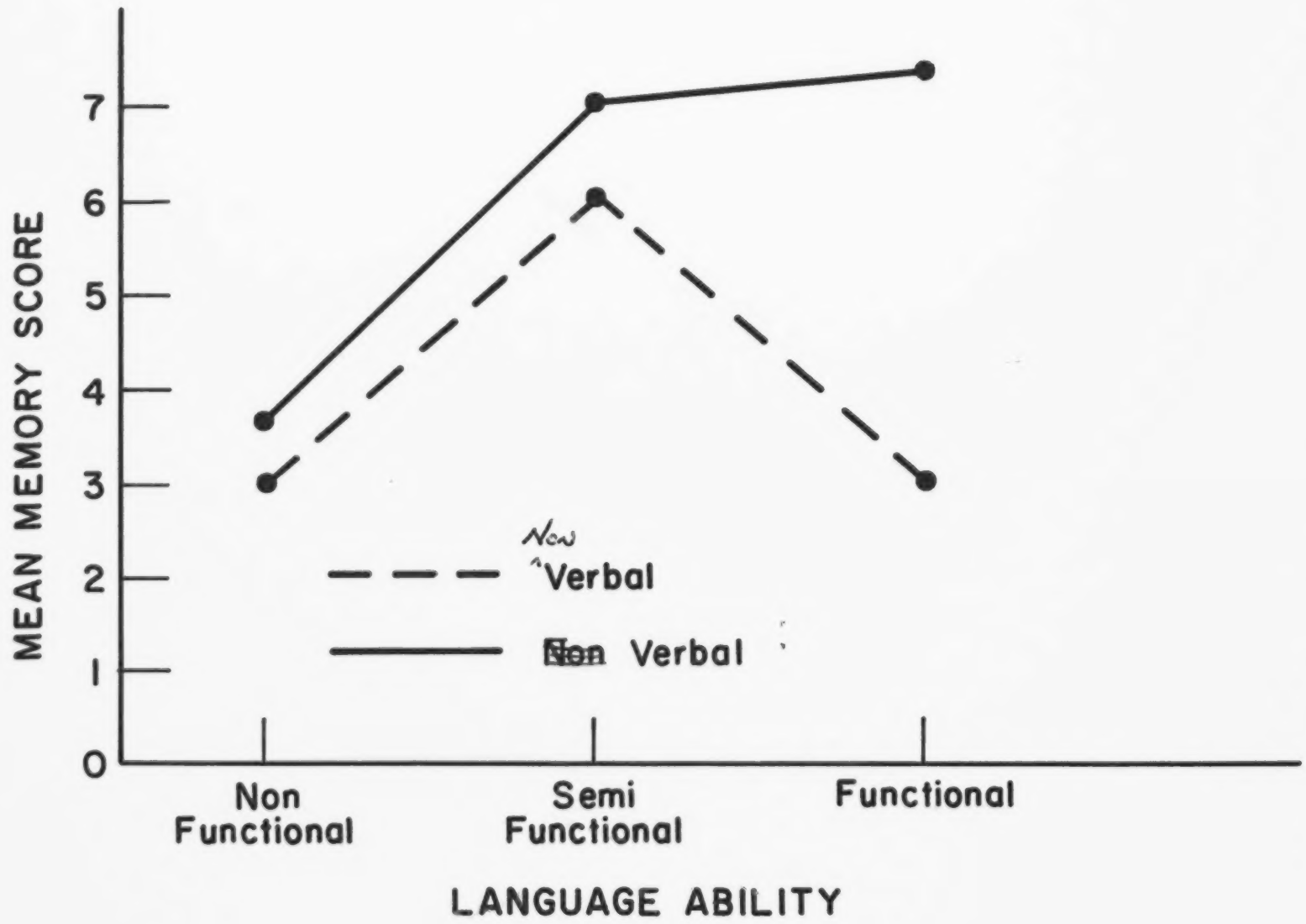
MEAN MEMORY SCORE
7
6
5
4
3
2
1
0
Verbal
Non Verbal
Non Functional
Semi Functional
Functional
LANGUAGE ABILITY

Fig. 3.

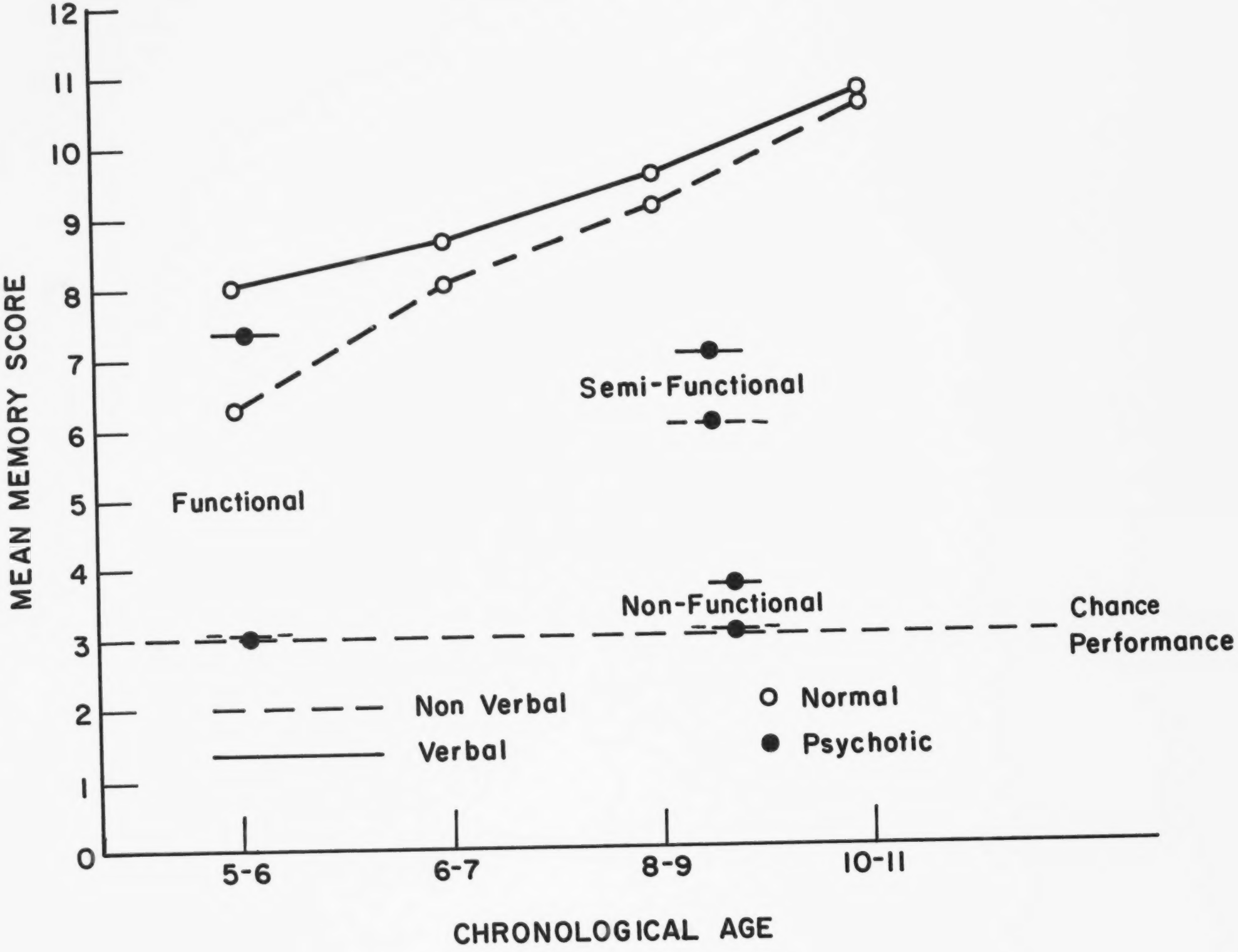
MEAN MEMORY SCORE
12
11
10
9
8
7
6
5
4
3
2
1
0
Functional
Semi-Functional
Non-Functional
Chance Performance
Non Verbal
Verbal
O Normal
● Psychotic
5-6
6-7
8-9
10-11
CHRONOLOGICAL AGE

Fig. 4.